Can we reverse the decline of Earth's habitability?

Wolfgang Cramer

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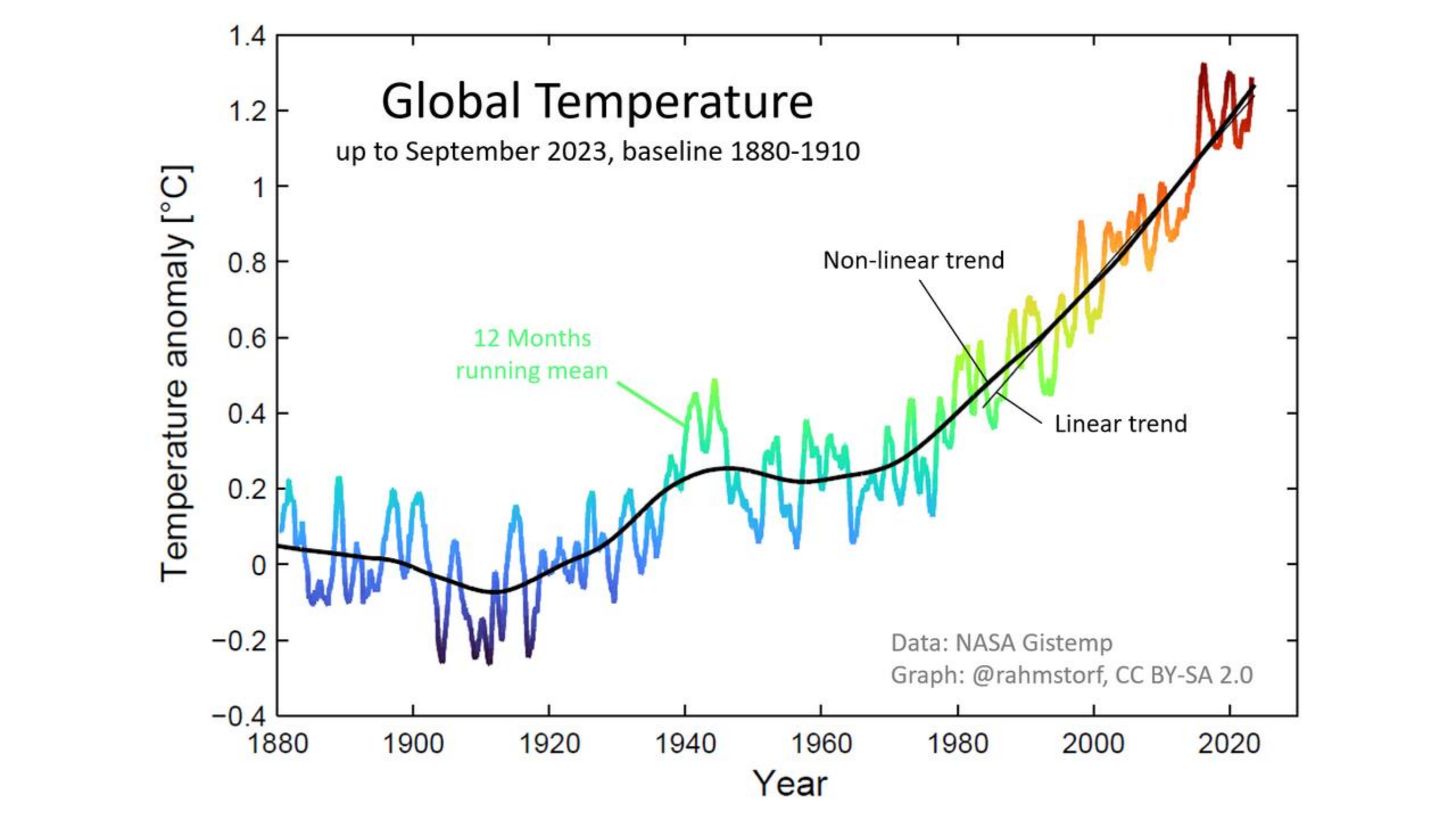
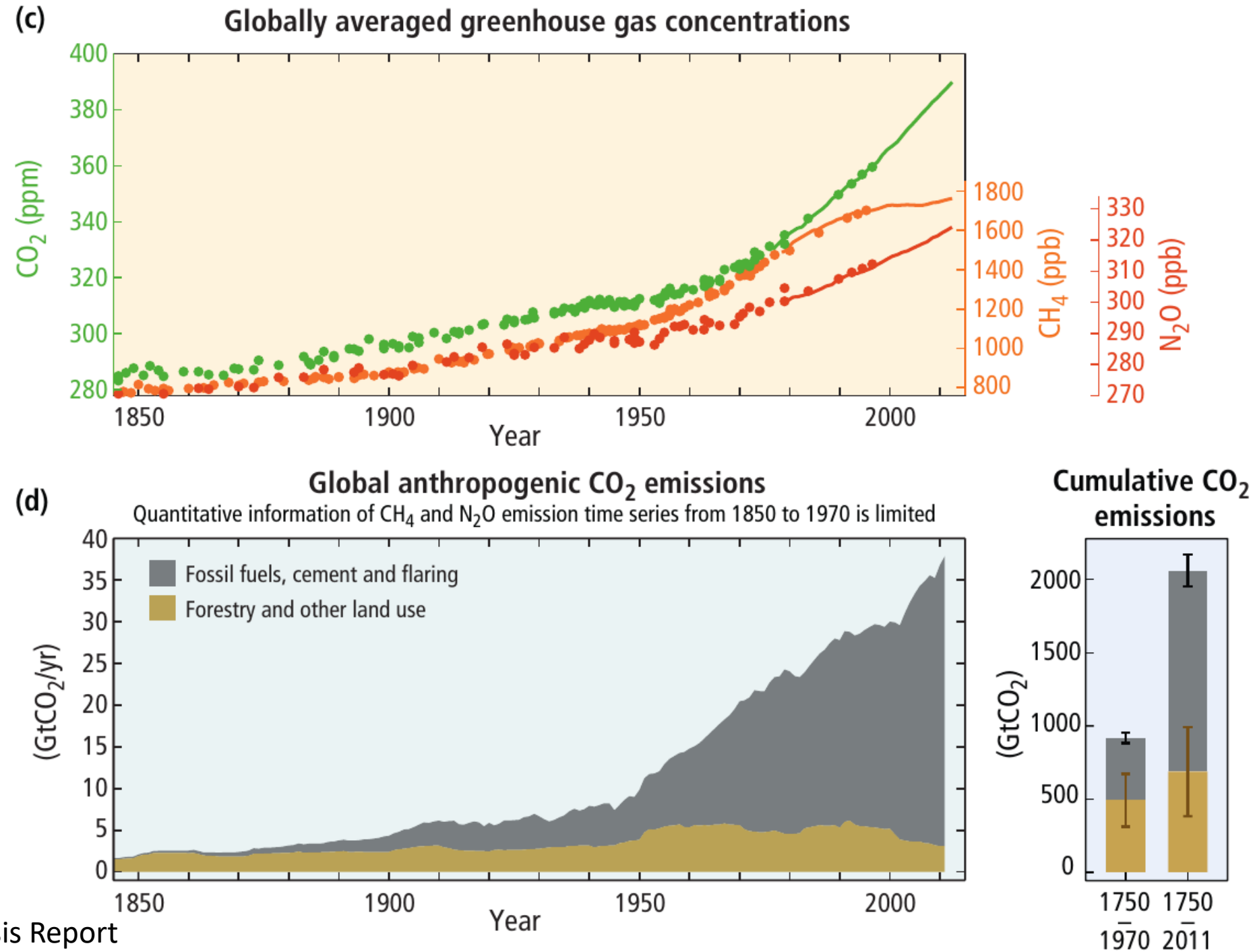
Aix-en-Provence

Reims, 15/02-2024

1. Status today
2. Projections
3. Responses
4. Transformation

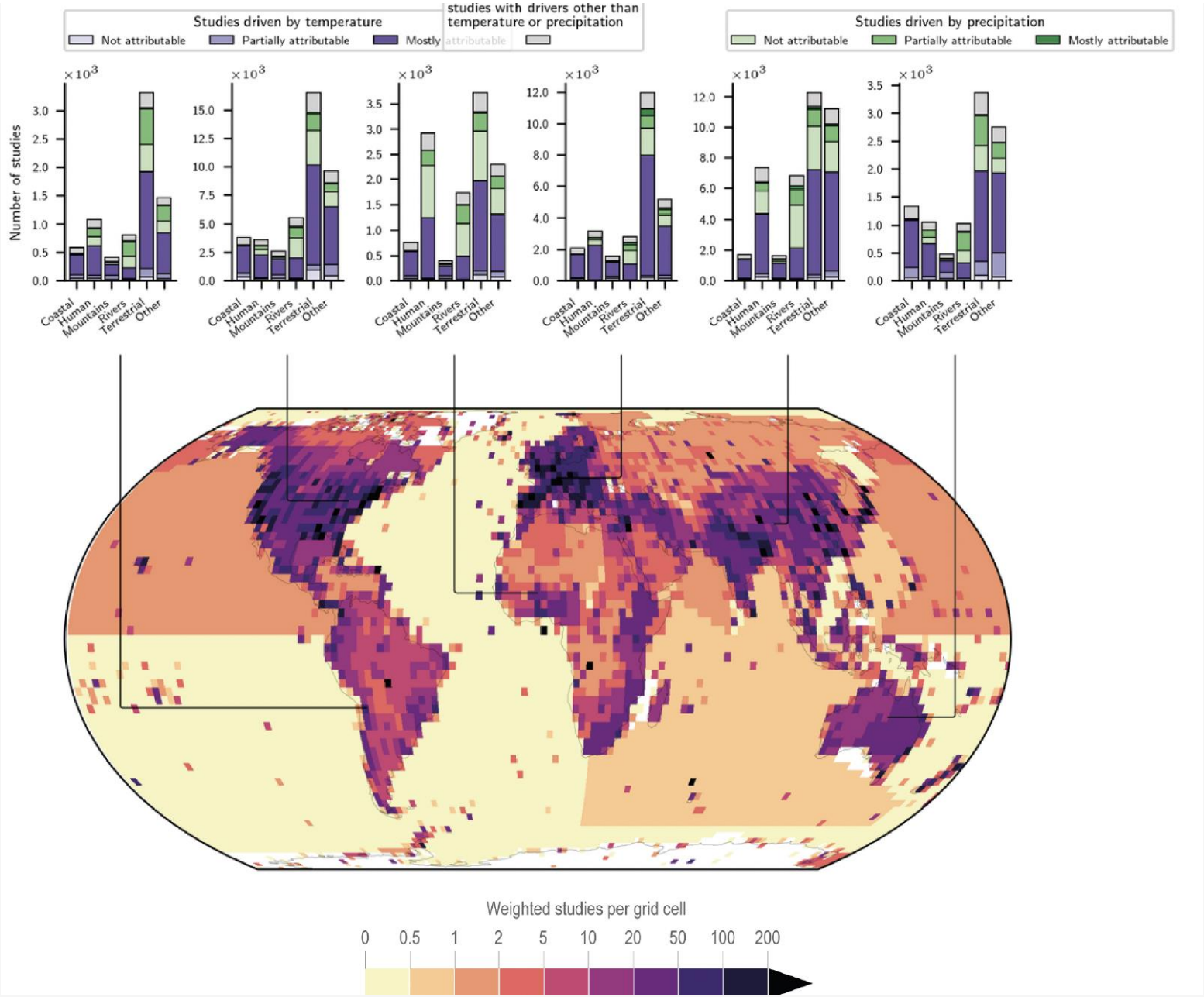
1. Status today


Global Temperature
up to September 2023, baseline 1880-1910
Temperature anomaly [°C]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
1880
1900
1920
1940
1960
1980
2000
2020
Year
12 Months
running mean
Non-linear trend
Linear trend
Data: NASA Gistemp
Graph: @rahmstorf, CC BY-SA 2.0



IPCC 2014 Synthesis Report

Climate change impacts everywhere (77785 studies)

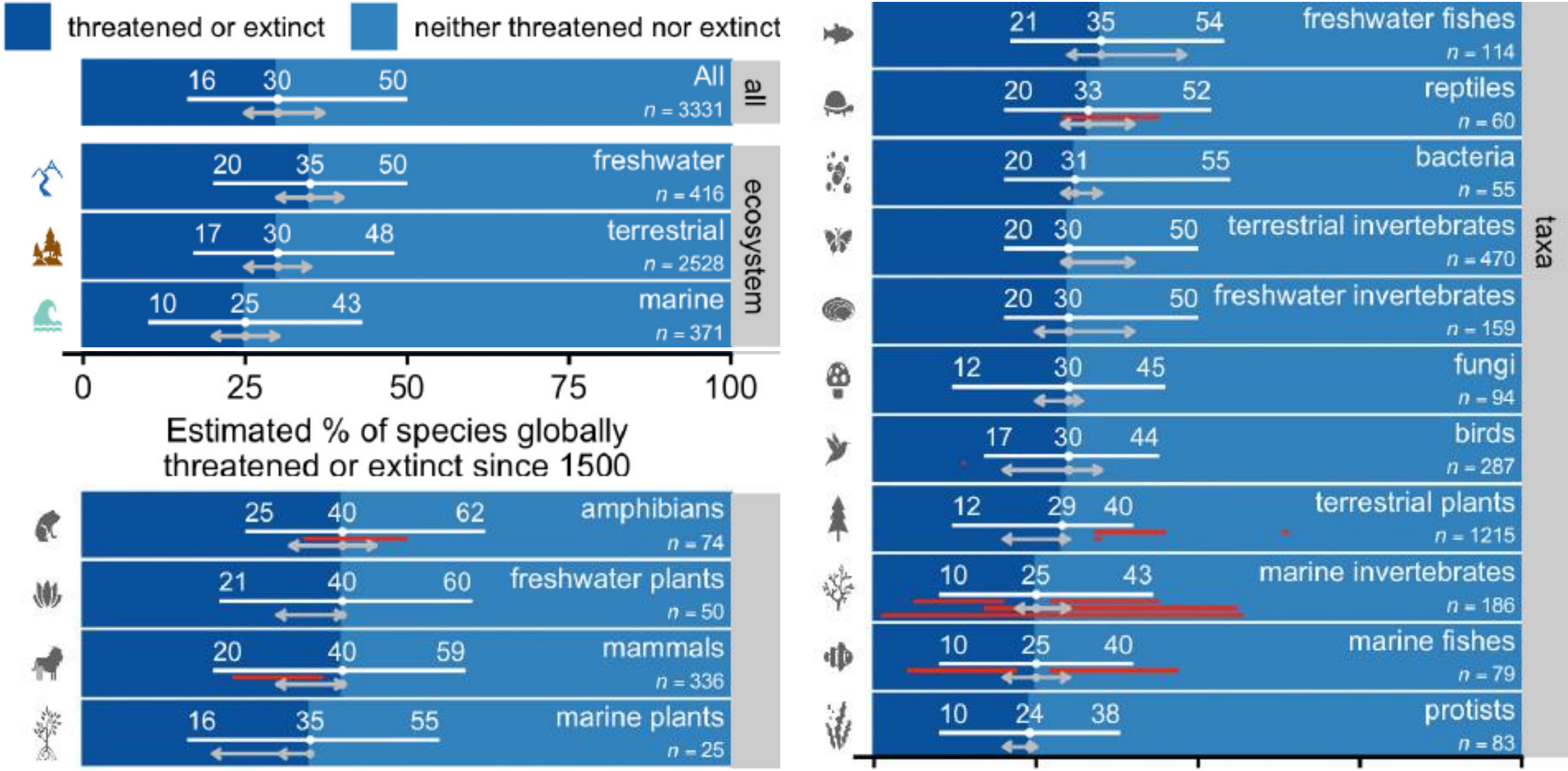


impact evidence, derived by machine-learning from 77,785 studies

Callaghan et al. 2021

Isbell et al. 2022

Species loss



Ecosystem loss

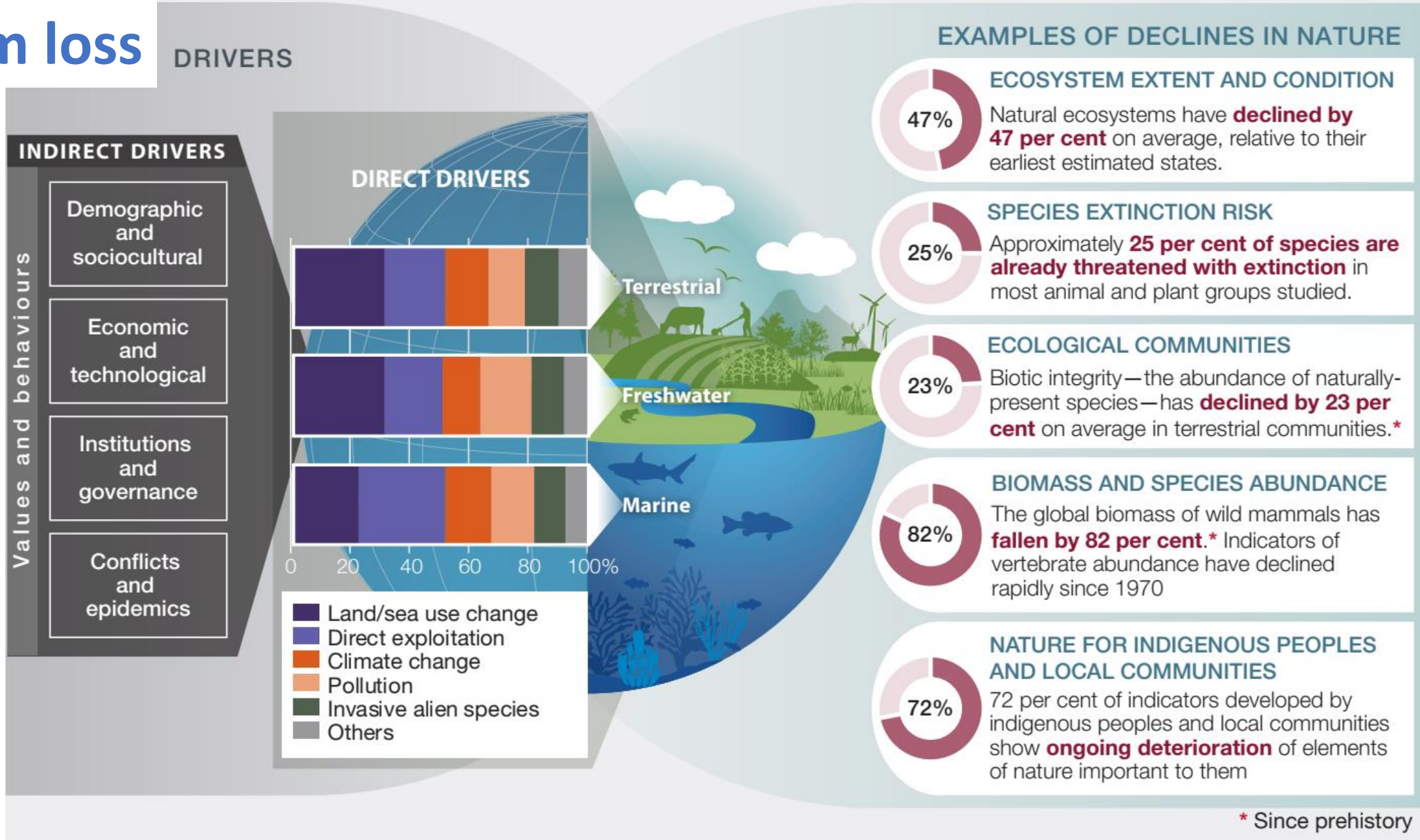


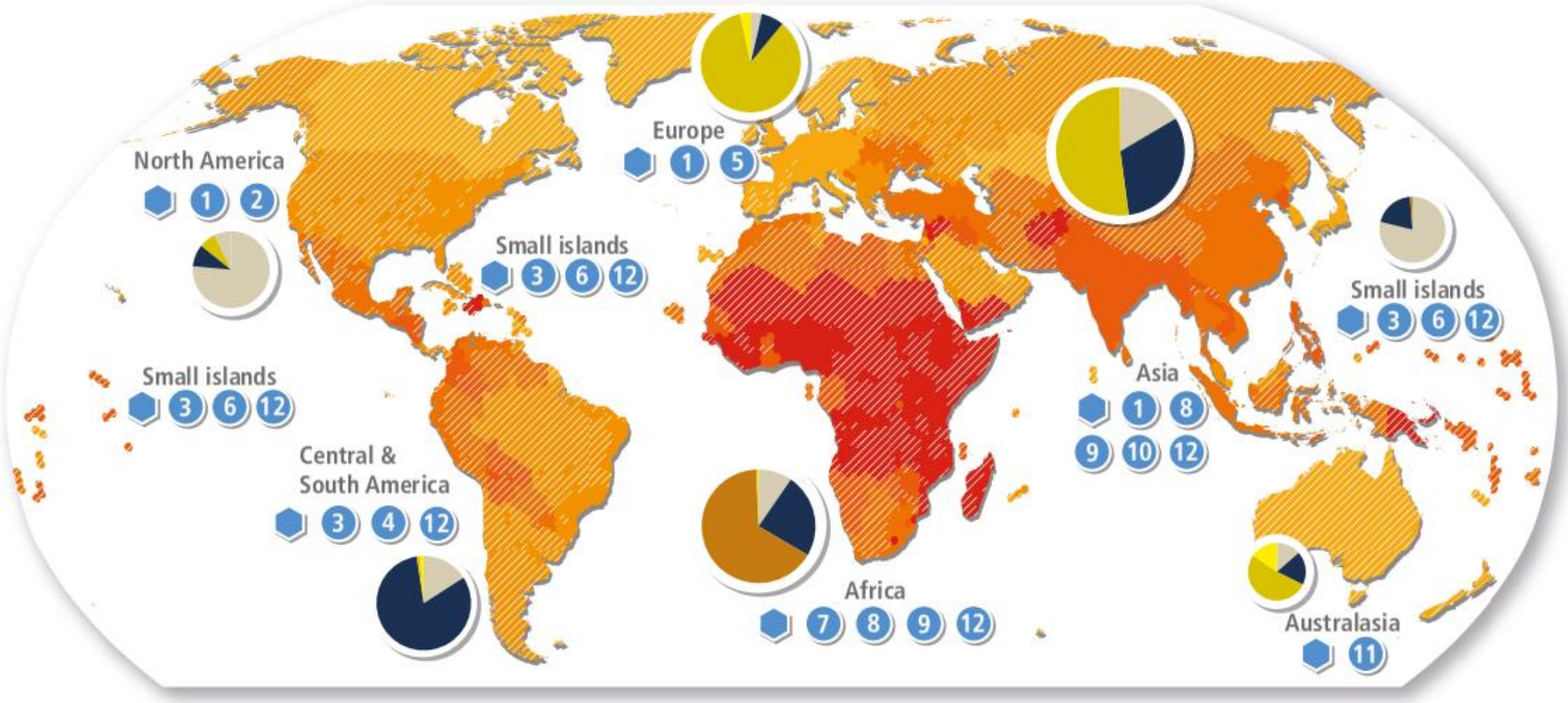
Figure SPM 2 **Examples of global declines in nature, emphasizing declines in biodiversity, that have been and are being caused by direct and indirect drivers of change.**

Malaga, Spain, 2022


Derna, Libya, Sept 2023

Observed human vulnerability to climate change is a key risk factor and differs globally

Vulnerability at the national level varies. Vulnerability also greatly differs within countries.
Countries with moderate or low average vulnerability have sub-populations with high vulnerability and vice versa.



Relative vulnerability

- Very high
- High
- Medium
- Low
- Very low

Population density

- High
- Low

Examples of Indigenous Peoples with high vulnerability to climate change and climate change responses (4.3.8, 5.10.2, 5.13.5, Box7.1, 8.2.1, 15.6.4) and the importance of Indigenous Knowledge (Box9.2.1, 11.4, 14.4, Cross-Chapter Box INDIG)

Pie charts

Flood Storm Drought Heat Wild Fires

The size of the pie charts show average mortality per hazard event per region between 2010 and 2020.
The slices of pie charts show the distribution of deaths from a particular hazard.

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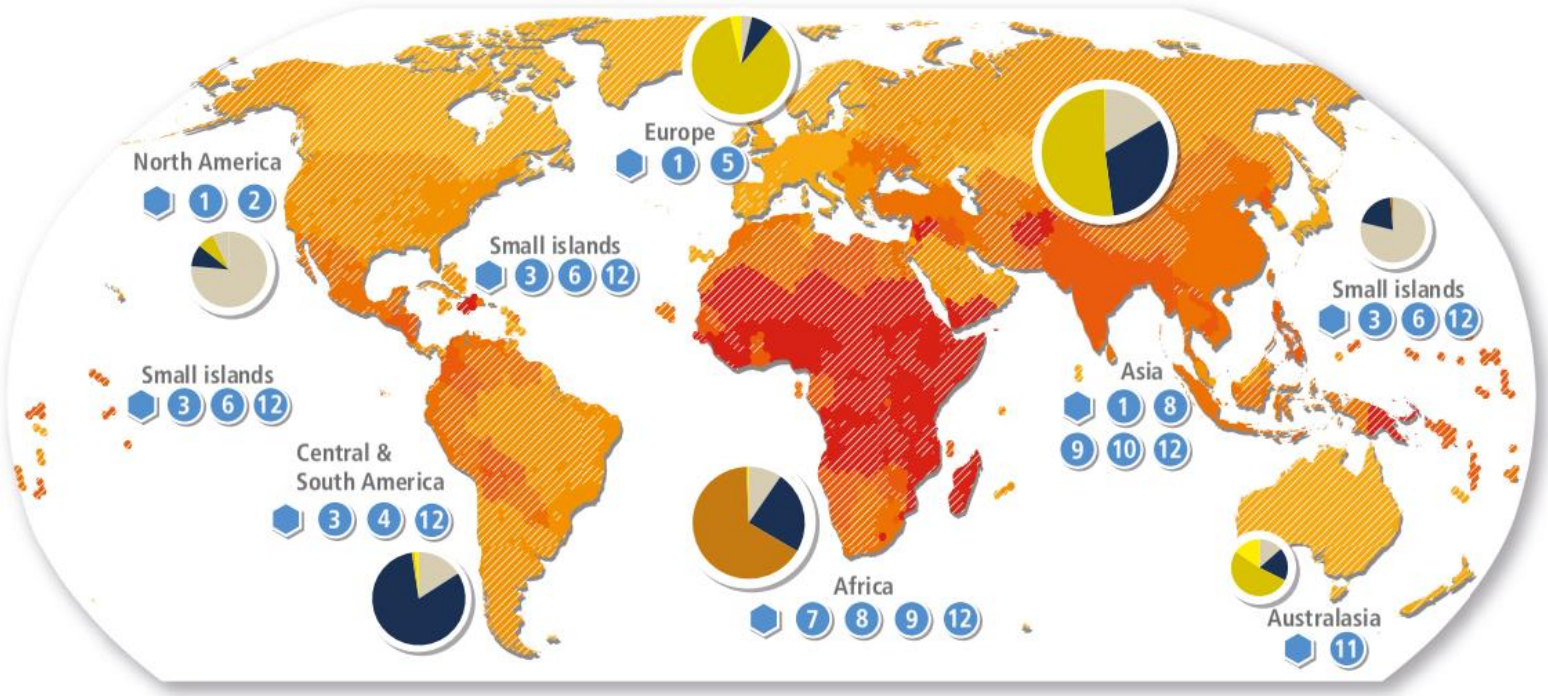

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Pie charts

Flood | Storm | Drought | Heat | Wild Fires

The size of the pie charts show average mortality per hazard event per region between 2010 and 2020.
The slices of pie charts show the distribution of deaths from a particular hazard.

Examples of vulnerable local groups across different contexts include the following:

1. **Indigenous Peoples of the Arctic** | health inequality, limited access to subsistence resources and culture | CCP 6.2.3, CCP 6.3.1
2. **Urban ethnic minorities** | structural inequality, marginalisation, exclusion from planning processes | 14.5.9, 14.5.5, 6.3.6
3. **Smallholder coffee producers** | limited market access & stability, single crop dependency, limited institutional support | 5.4.2
4. **Indigenous Peoples in the Amazon** | land degradation, deforestation, poverty, lack of support | 8.2.1, Box 8.6
5. **Older people, especially those poor & socially isolated** | health issues, disability, limited access to support | 8.2.1, 13.7.1, 6.2.3, 7.1.7
6. **Island communities** | limited land, population growth and coastal ecosystem degradation | 15.3.2
7. **Children in rural low-income communities** | food insecurity, sensitivity to undernutrition and disease | 5.12.3
8. **People uprooted by conflict in the Near East and Sahel** | prolonged temporary status, limited mobility | Box 8.1, Box 8.4
9. **Women & non-binary** | limited access to & control over resources, e.g. water, land, credit | Box 9.1, CCB-GENDER, 4.8.3, 5.4.2, 10.3.3
10. **Migrants** | informal status, limited access to health services & shelter, exclusion from decision-making processes | 6.3.6, Box 10.2
11. **Aboriginal and Torres Strait Islander Peoples** | poverty, food & housing insecurity, dislocation from community | 11.4.1
12. **People living in informal settlements** | poverty, limited basic services & often located in areas with high exposure to climate hazards | 6.2.3, Box 9.1, 9.9, 10.4.6, 12.3.2, 12.3.5, 15.3.4

Vulnerability and Exposure of Ecosystems and People

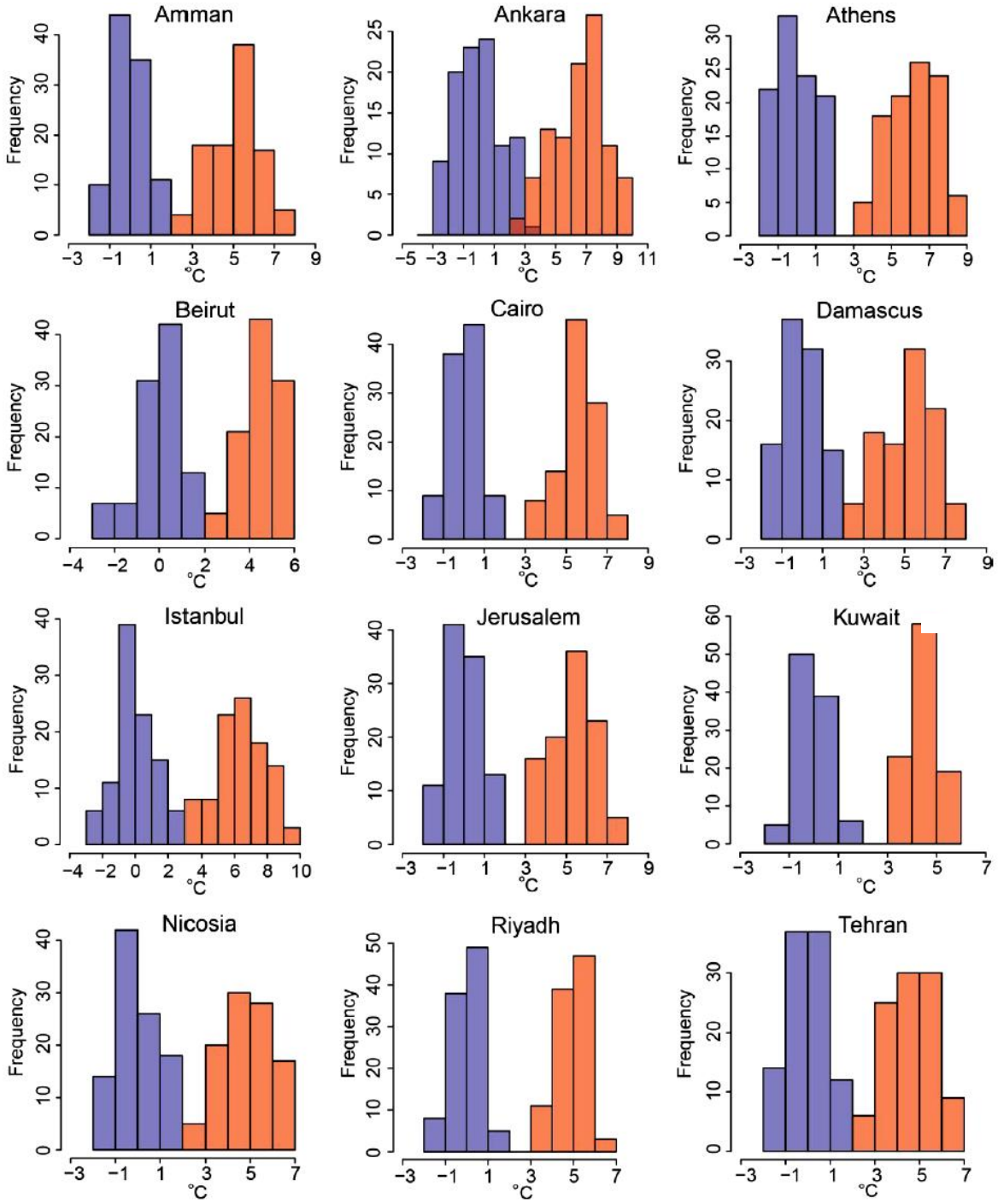
B.2 Vulnerability of ecosystems and people to climate change differs substantially among and within regions (*very high confidence*), driven by patterns of intersecting socioeconomic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism, and governance[31] (*high confidence*). Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change (*high confidence*). A high proportion of species is vulnerable to climate change (*high confidence*). Human and ecosystem vulnerability are interdependent (*high confidence*). Current unsustainable development patterns are increasing exposure of ecosystems and people to climate hazards (*high confidence*). {2.3, 2.4, 3.5, 4.3, 6.2, 8.2, 8.3, 9.4, 9.7, 10.4, 12.3, 14.5, 15.3, CCP5.2, CCP6.2, CCP7.3, CCP7.4, CCB GENDER}

Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change.

2. Projections

Urban warming in MENA cities

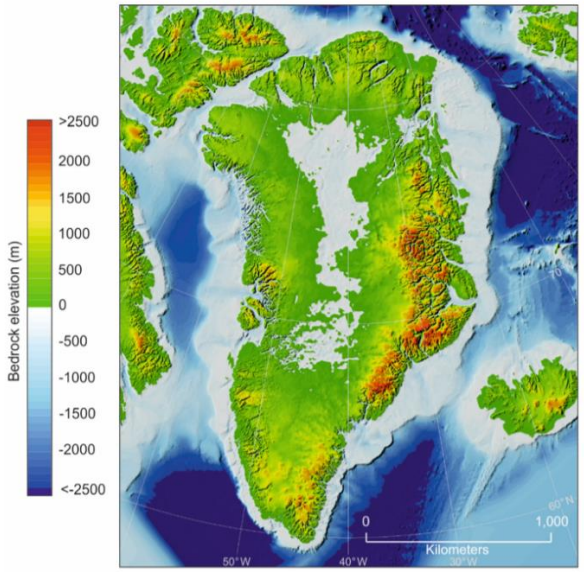
For most large cities in the MENA Region **the coldest summer month in the future will be warmer than today's hottest month**

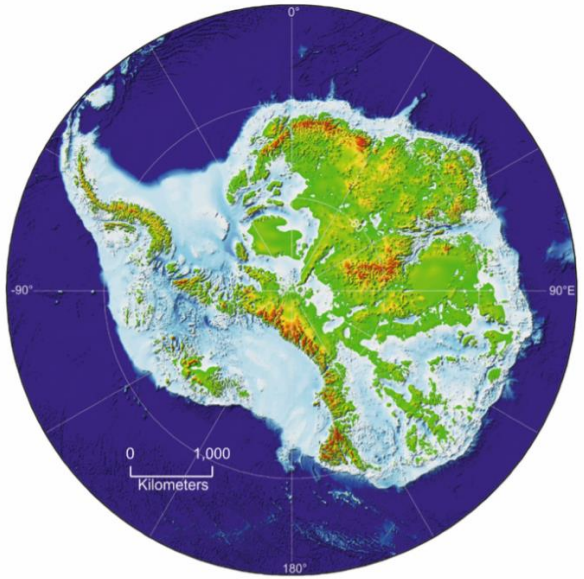


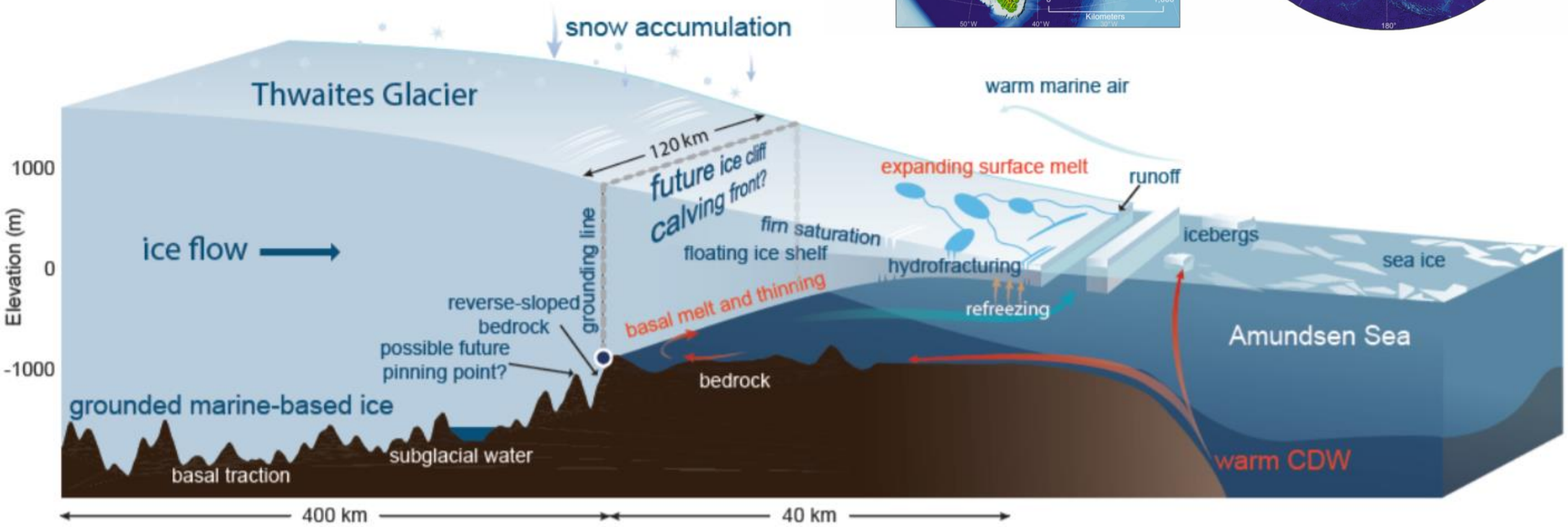
Recent and end-of-century temperature anomalies. Model calculated frequency histograms (%) of **summer (JJA) daytime maximum temperature** (TX) anomalies relative to the period 1961-1990, based on the A1B scenario. Blue is for the period 1961-1990 (hence cantered around 0°C) and red for the period 2070-2099

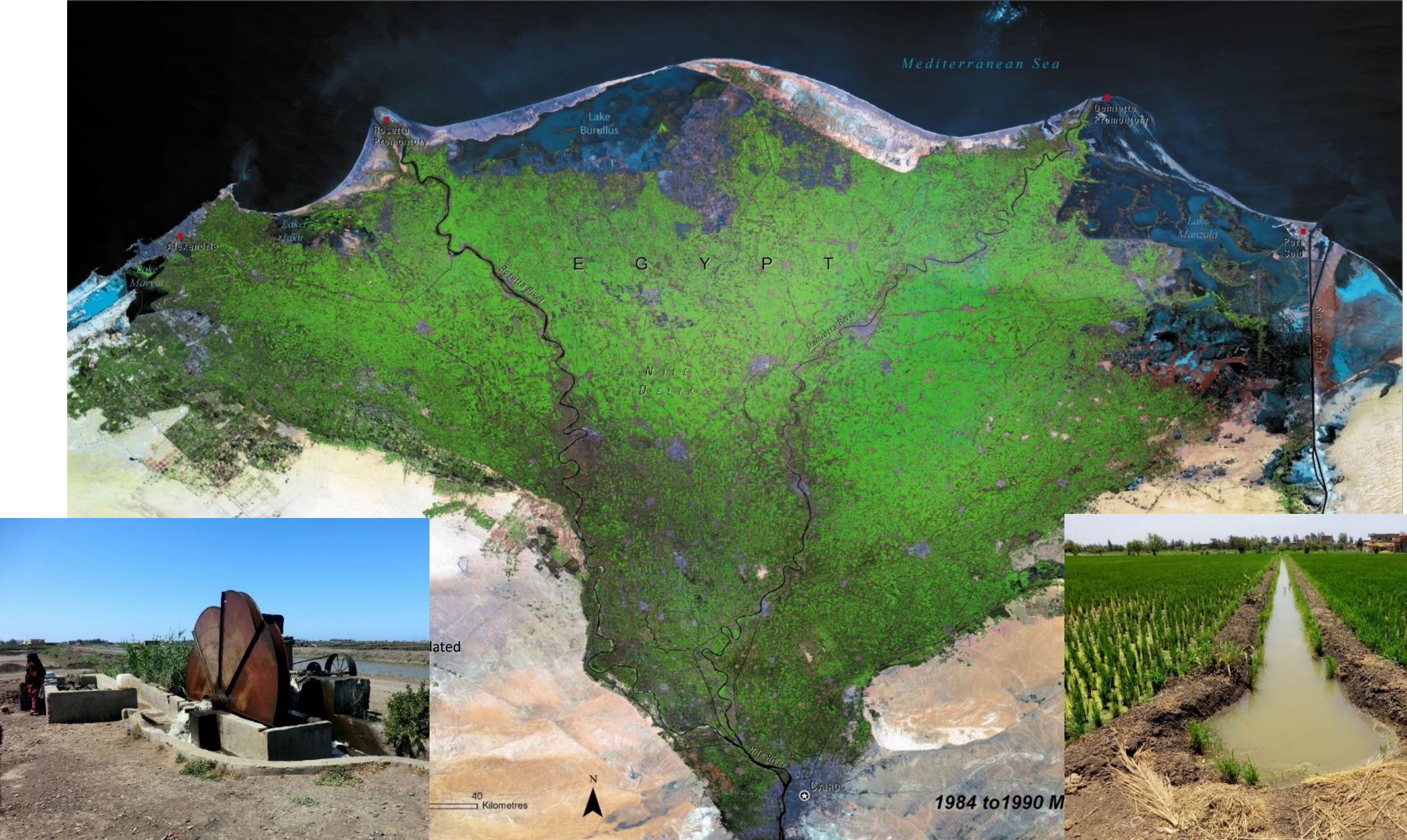
Lelieveld et al. 2014, Regional Environmental Change

Antarctic deglaciation





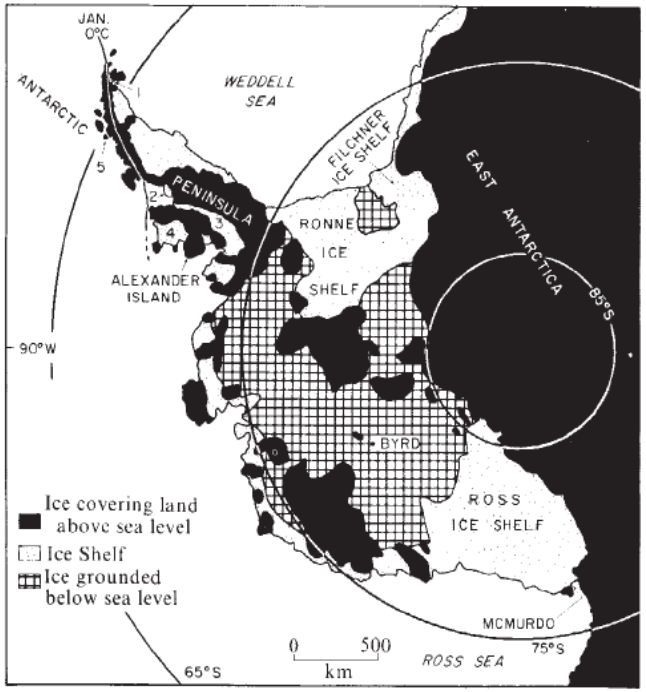



Mediterranean Sea
Rosetta Promontory
Lake Burullus
Damietta Promontory
Lake Mariout
Alexandria
Lake Idku
Lake Manzala
Port Said
E G Y P T
Rosetta River
Damietta River
NILE DELTA
Suez Canal
Nile River
CAIRO
N
40
Kilometres
1984 to1990 M

West Antarctic ice sheet and CO_2 greenhouse effect: a threat of disaster

J. H. Mercer

Fig. 2 West Antarctica, showing ice shelves, ice grounded below sea level, ice covering land above sea level, and position of the 0 °C January isotherm in the Antarctic Peninsula (based on information up to the year 1962)[36]. 1, Prince Gustav Channel; 2, Wordie Ice Shelf; 3, George VI Sound; 4, Wilkins Sound; 5, Argentine Island.



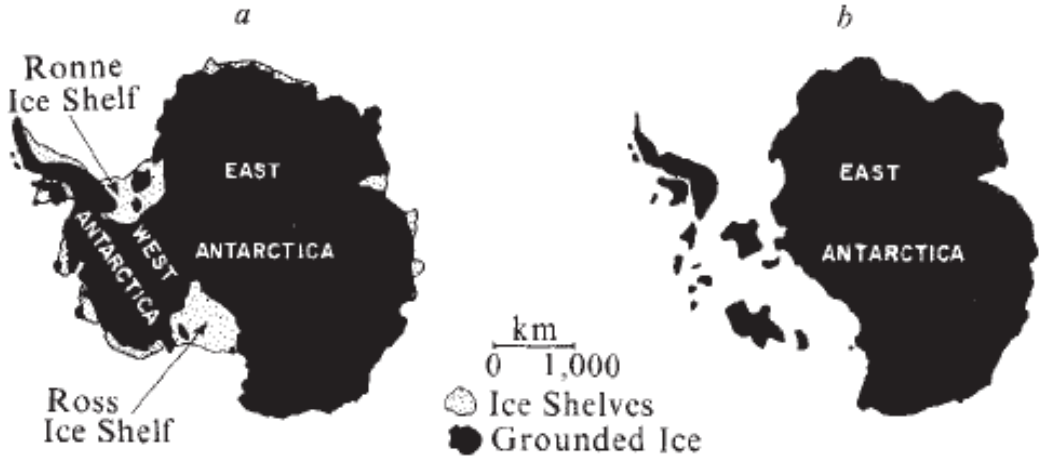
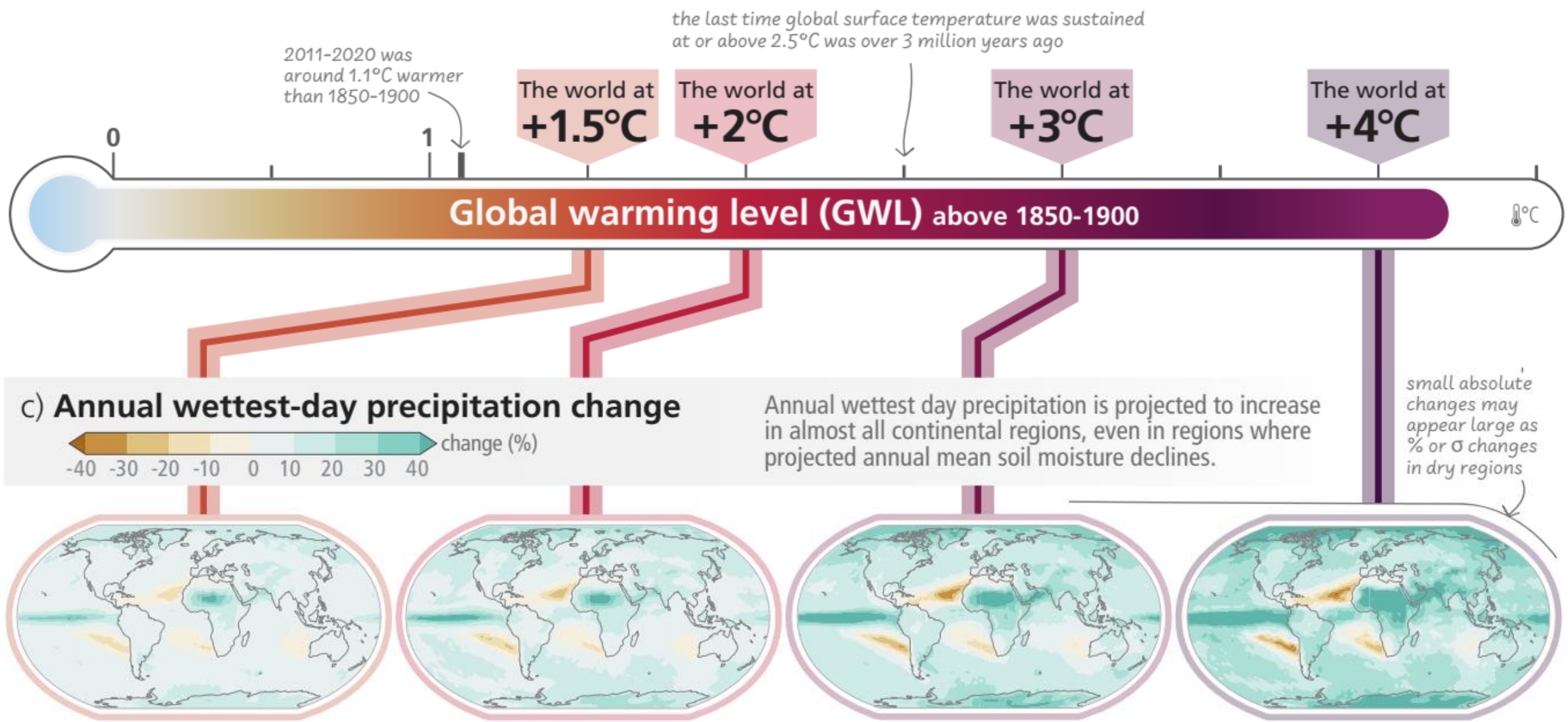


Fig. 3 *a*, Antarctic ice cover today, and *b*, after a 5–10 °C warming.

If the recent growth rate of fossil fuel consumption continues, atmospheric CO_2 content is expected to double in about 50 yr. Present models of the climatic effects of this doubling compute a rise in temperature that could cause rapid deglaciation of West Antarctica, leading to a 5 m rise in sea level. Although

Nature Vol. 271 26 January 1978

With every increment of global warming, regional changes in mean climate and extremes become more widespread and pronounced

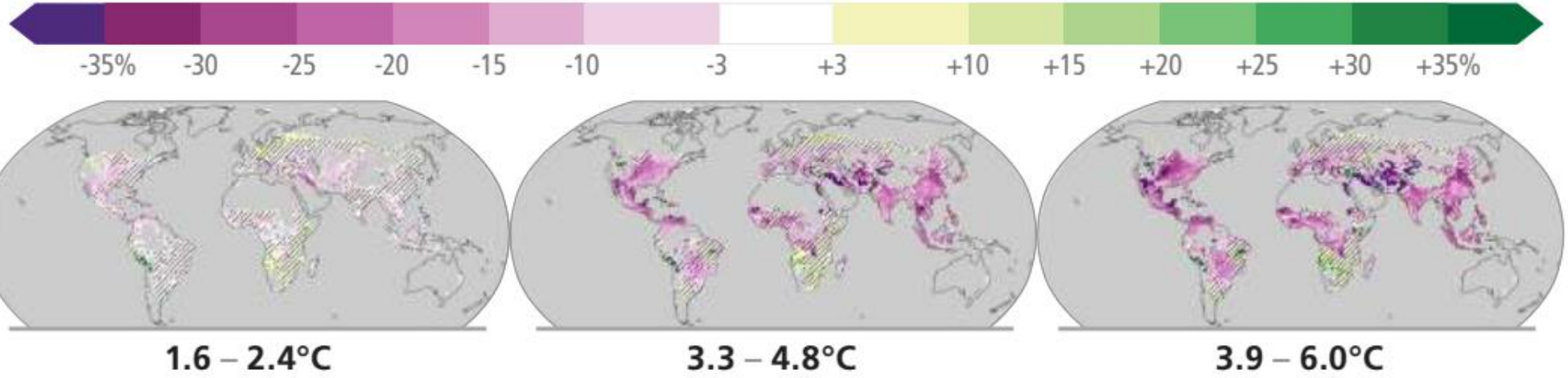


of droughts that occurred about once every six years during 1850–1900. The WGI Interactive Atlas (https://interactive-atlas.ipcc.ch/) can be used to explore additional changes in the climate system across the range of global warming levels presented in this figure. {*Figure 3.1, Cross-Section Box.2*}

Future climate change is projected to increase the severity of impacts across natural and human systems and will increase regional differences

Examples of impacts without additional adaptation

c) Food production impacts



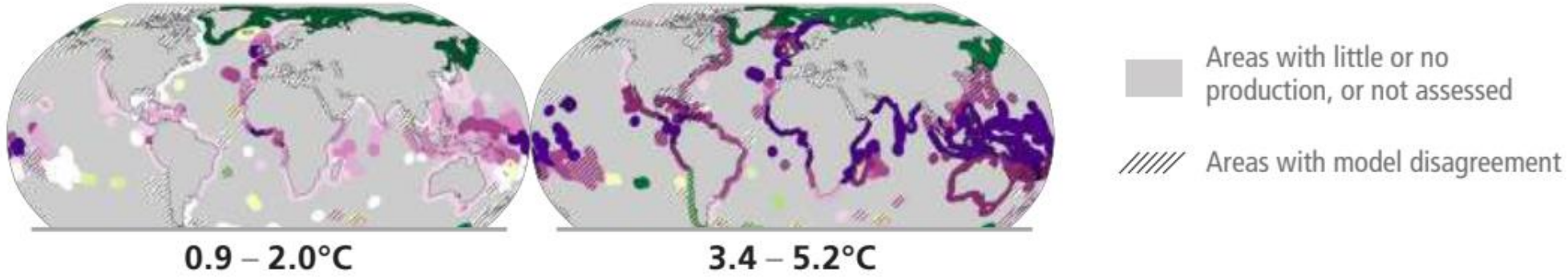
c1) Maize yield[4]

Changes (%) in yield

[4]Projected regional impacts reflect biophysical responses to changing temperature, precipitation, solar radiation, humidity, wind, and CO_2 enhancement of growth and water retention in currently cultivated areas. Models assume that irrigated areas are not water-limited. Models do not represent pests, diseases, future agro-technological changes and some extreme climate responses.

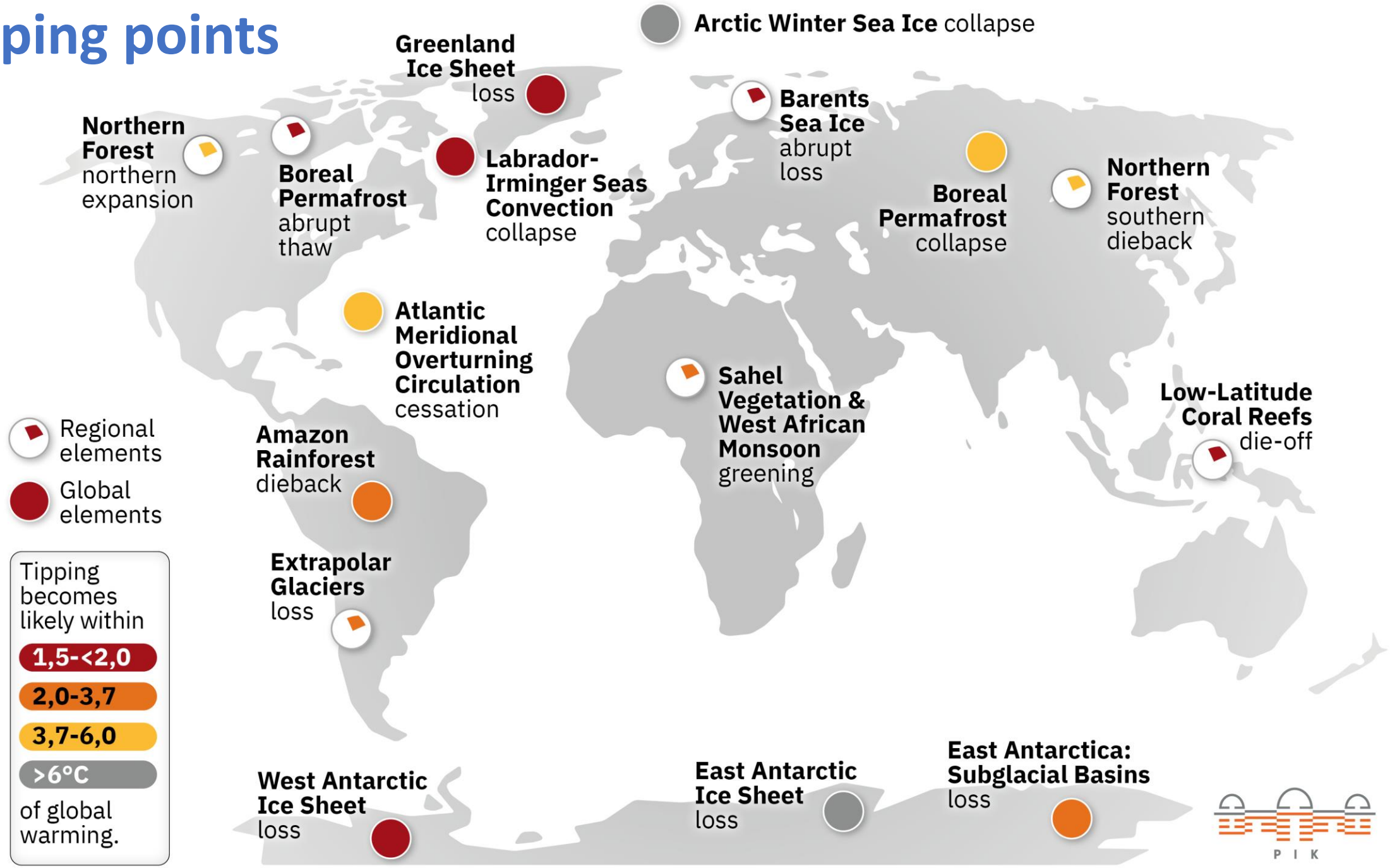
c2) Fisheries yield[5]

Changes (%) in maximum catch potential



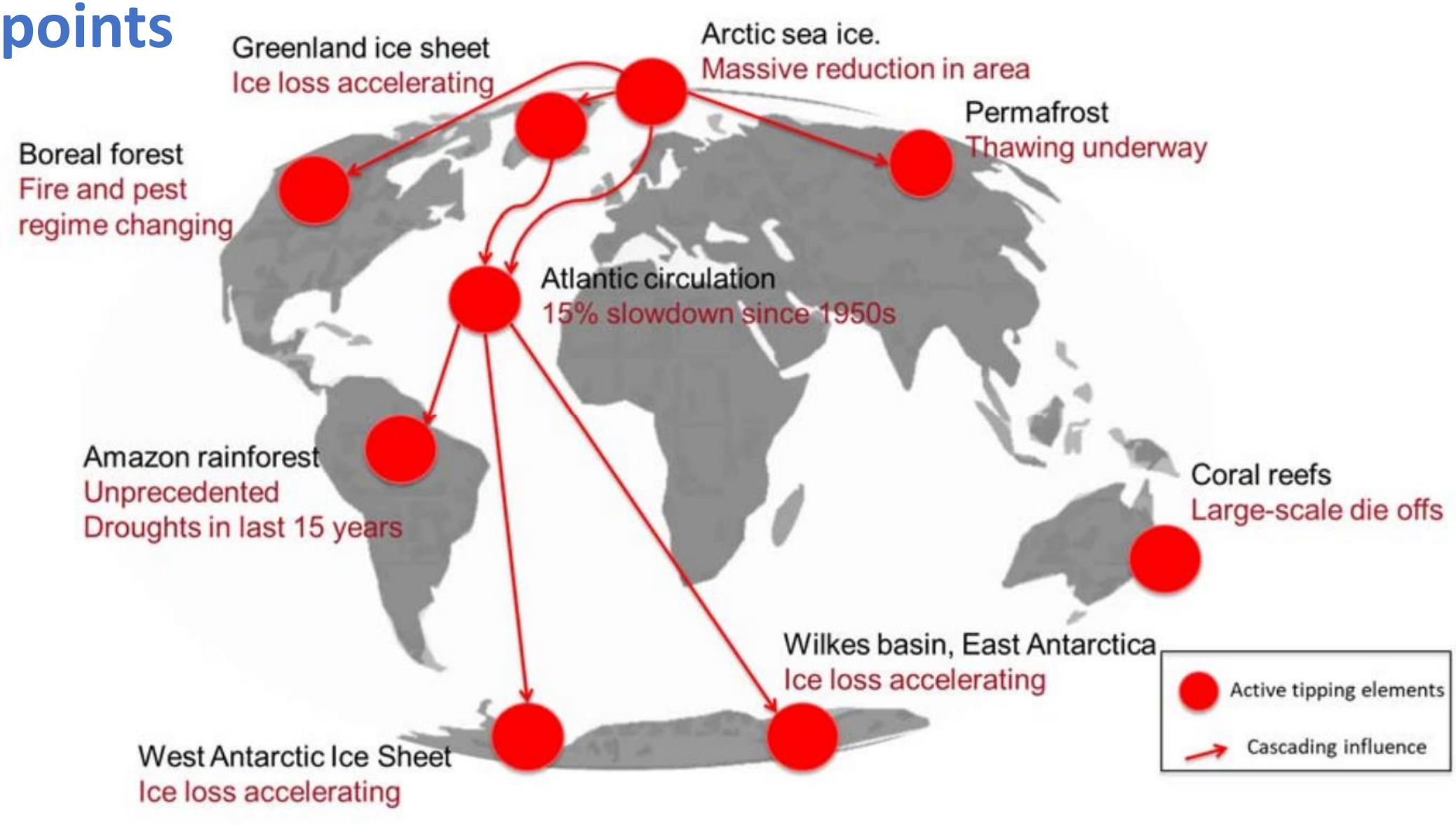
[5]Projected regional impacts reflect fisheries and marine ecosystem responses to ocean physical and biogeochemical conditions such as temperature, oxygen level and net primary production. Models do not represent changes in fishing activities and some extreme climatic conditions. Projected changes in the Arctic regions have low confidence due to uncertainties associated with modelling multiple interacting drivers and ecosystem responses.

Tipping points



Armstrong McKay et al. 2022

Tipping points



Change underway. Several tipping elements in the climate system now show greater changes than were recognised just a decade ago[1] and new tipping elements have also been identified.

Lenton et al. 2019

3. Responses

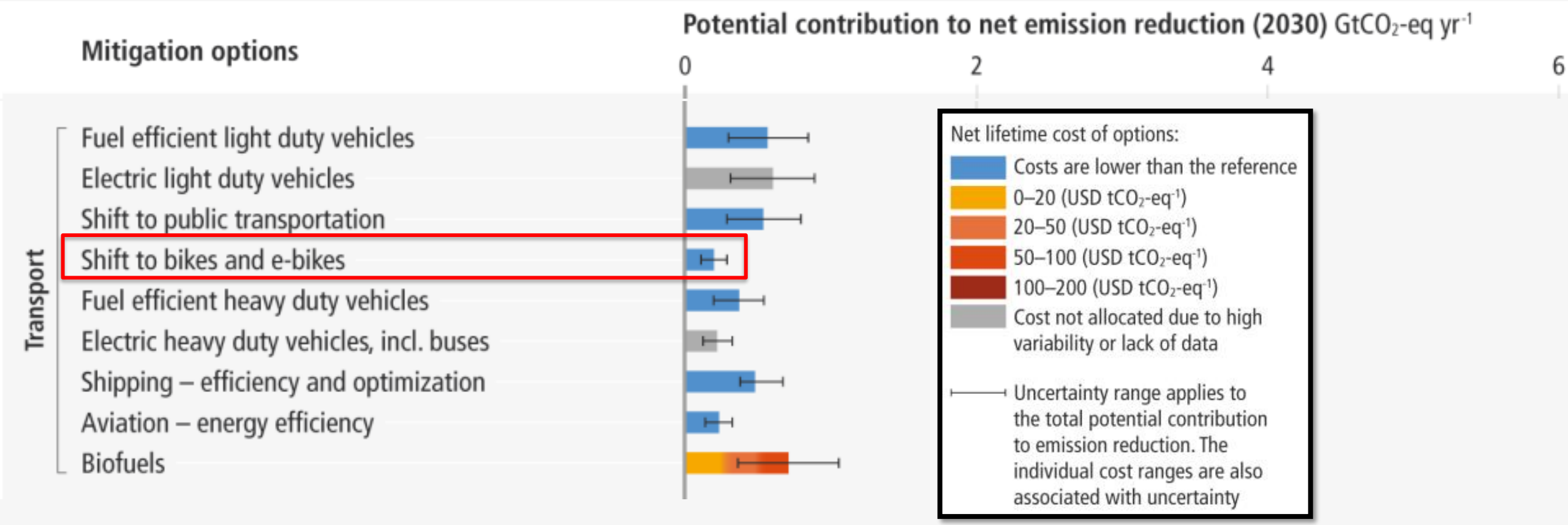
UN Framework Convention on Climate Change (1992)

ARTICLE 2

OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Shift to bikes and e-bikes is a modest, yet cheap, mitigation option

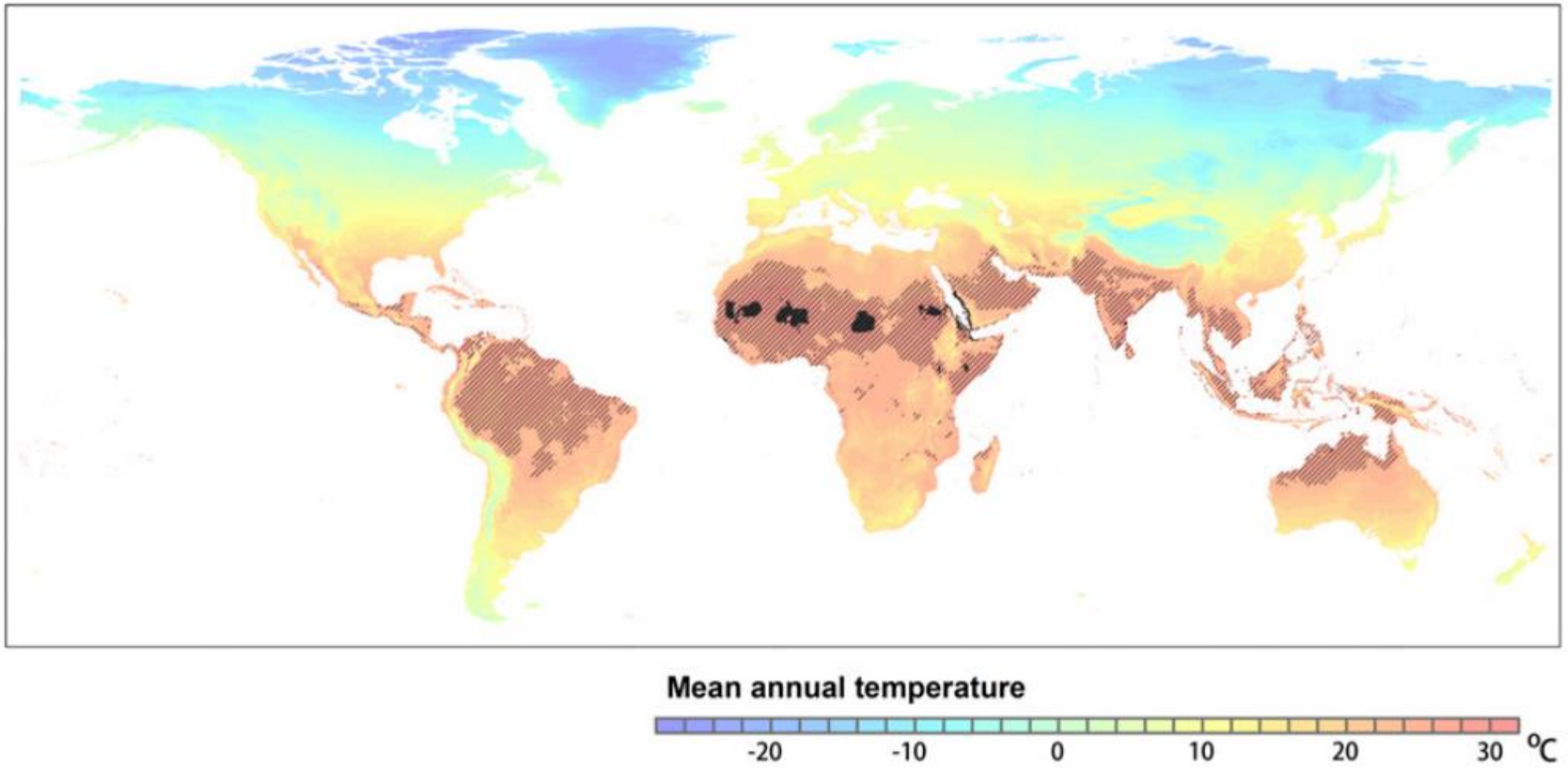


(Le Cozannet, Masson-Delmotte and friends 2022)

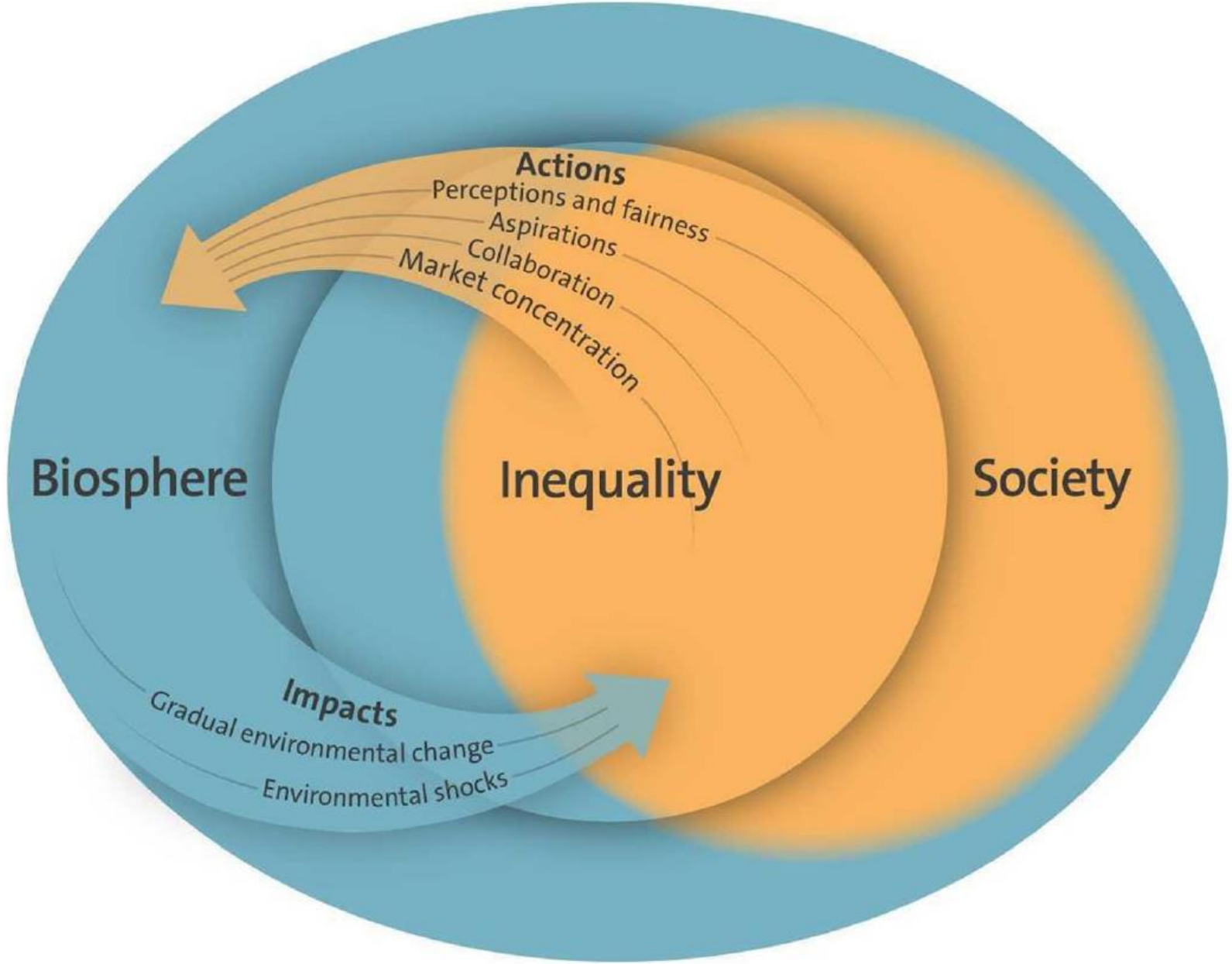
Habitability

…the physical and social conditions required for decent human and non-human life on Earth…

The human climate niche

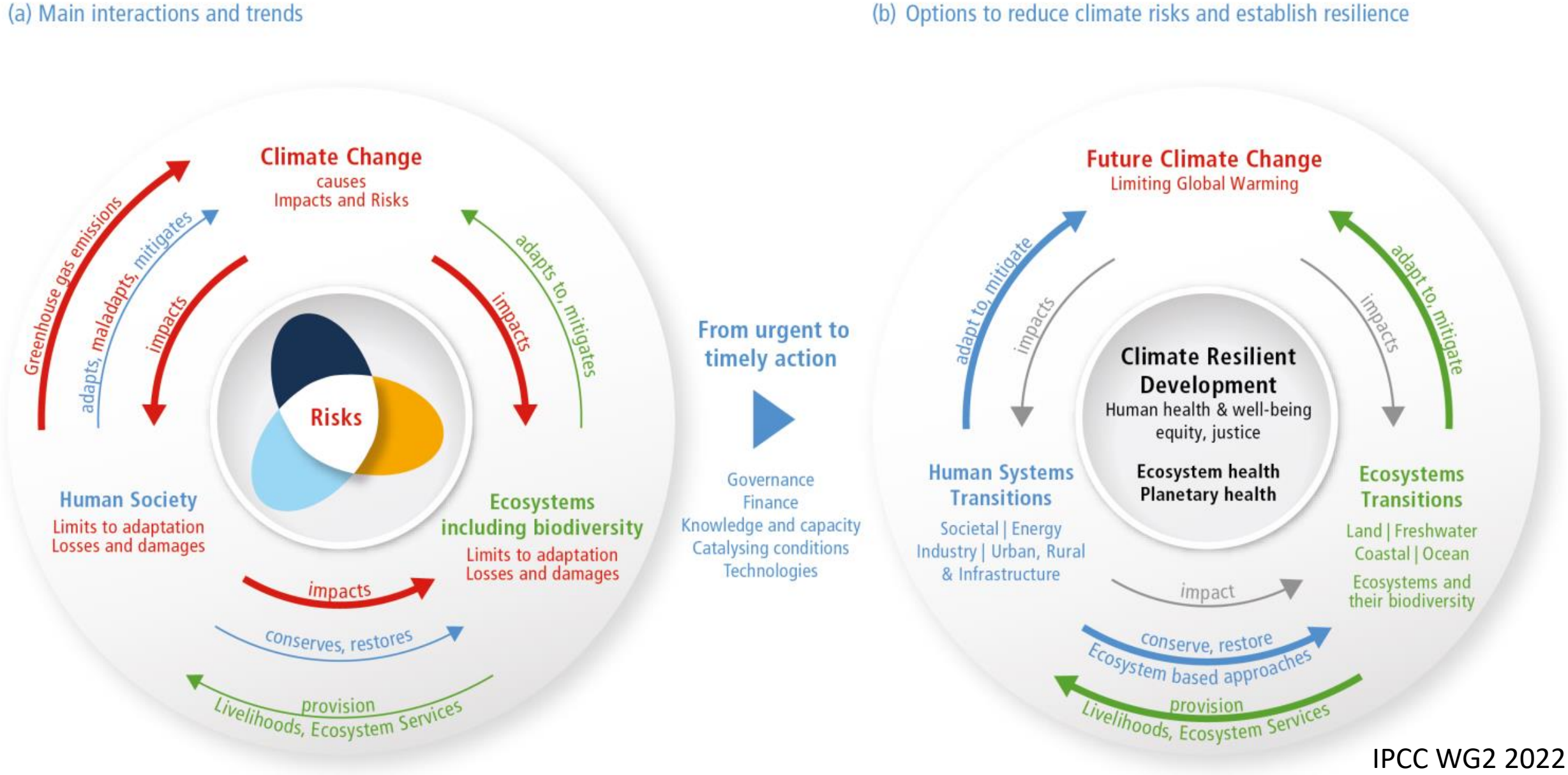


Expansion of extremely hot regions in a business-as-usual climate scenario. In the current climate, MATs >29 °C are restricted to the small dark areas in the Sahara region. In 2070, such conditions are projected to occur throughout the shaded area following the RCP8.5 scenario. Absent migration, that area would be home to 3.5 billion people in 2070 following the SSP3 scenario of demographic development. Background colors represent the current MATs. Xu et al. 2020



Folke et al 2021, adapted from Hamann 2018

Climate-resilient development

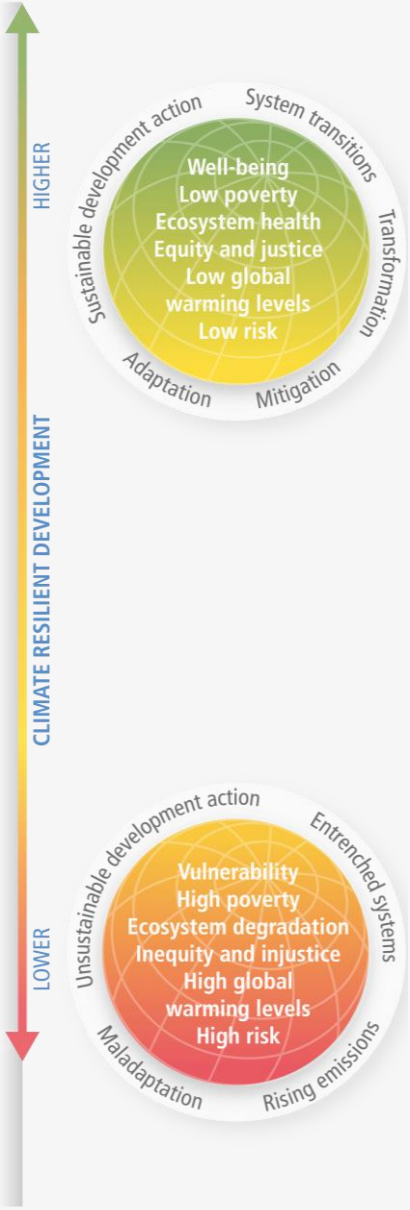


IPCC WG2 2022

Our future?

- Reduced climate risks – adaptation
- Reduced greenhouse gas emissions – mitigation
- Enhanced biodiversity
- Achieved the Sustainable Development Goals

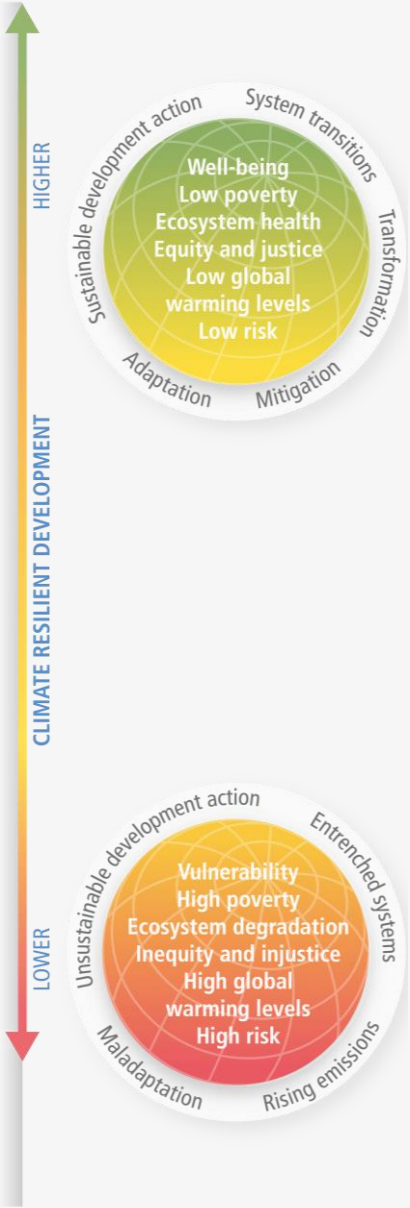
This is Climate Resilient Development.



Climate Resilient Development

The solutions framework:

- Is considered across government and all of civil society
- Involves everyone – forming partnerships



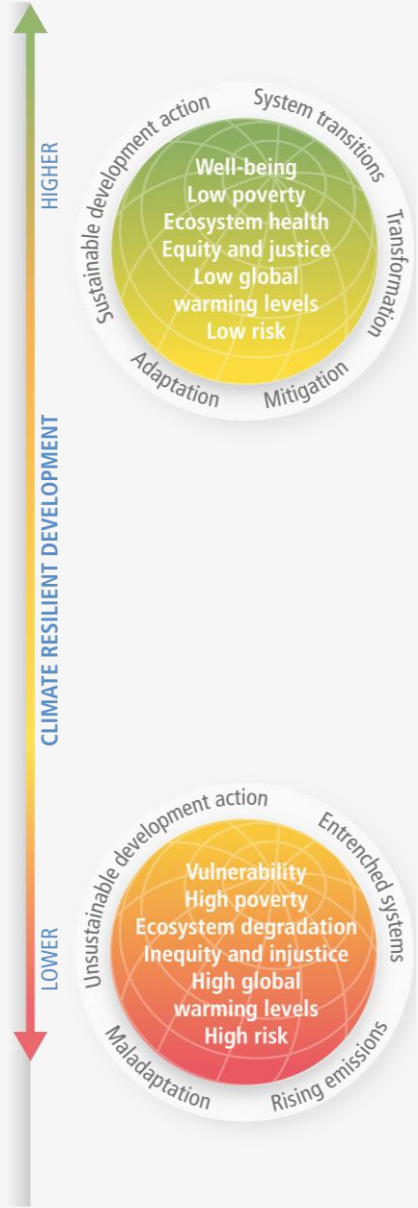
[GovernmentZA_DIRCO_CC BY-ND 2.0; Marlon del Aguila/CIFOR CC BY-NC-ND 2.0]

Climate Resilient Development

The solutions framework:

- Draws on wide-ranging knowledge (scientific, Indigenous, local, practical)

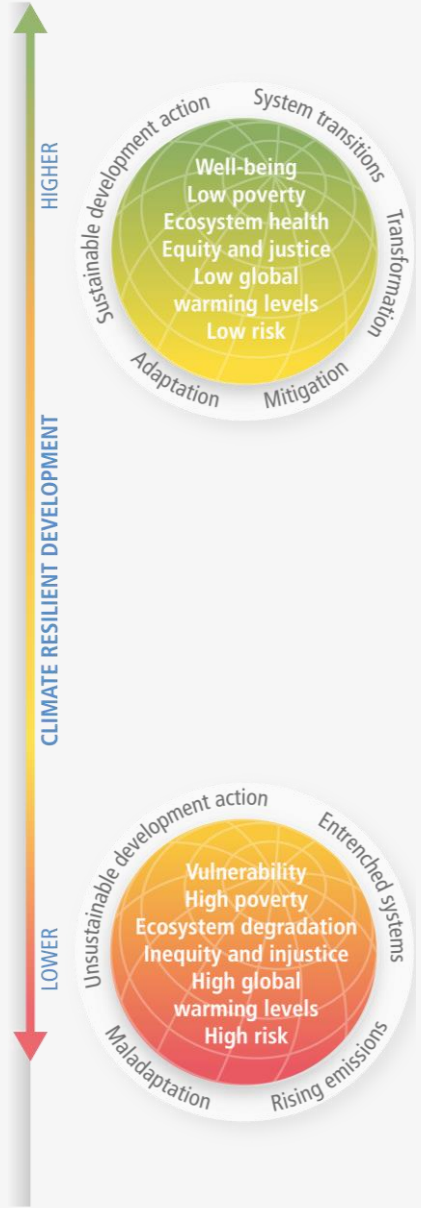
[thisisengineering-raeng / Unsplash; Aris Sanjaya/CIFOR CC BY-NC-ND 2.0]



Climate Resilient Development

The solutions framework:

- Conserves and restores ecosystems

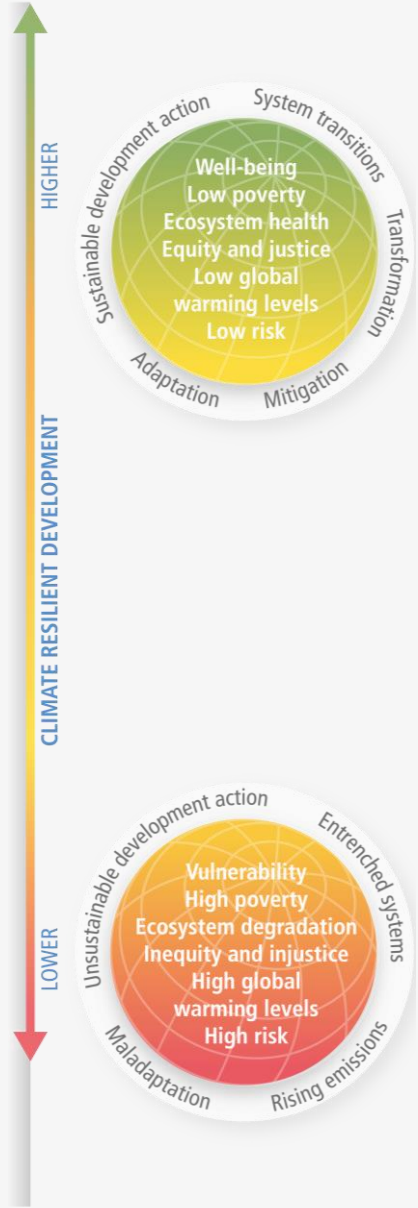


[Yuichi Ishida/UNDP Timor-Leste CC BY-NY 2.0; Axel Fassio/CIFOR CC BY-NC-ND 2.0]

Climate Resilient Development

The solutions framework:

- Involves marginalized groups
- Prioritises equity and justice
- Reconciles different interests, values and world views

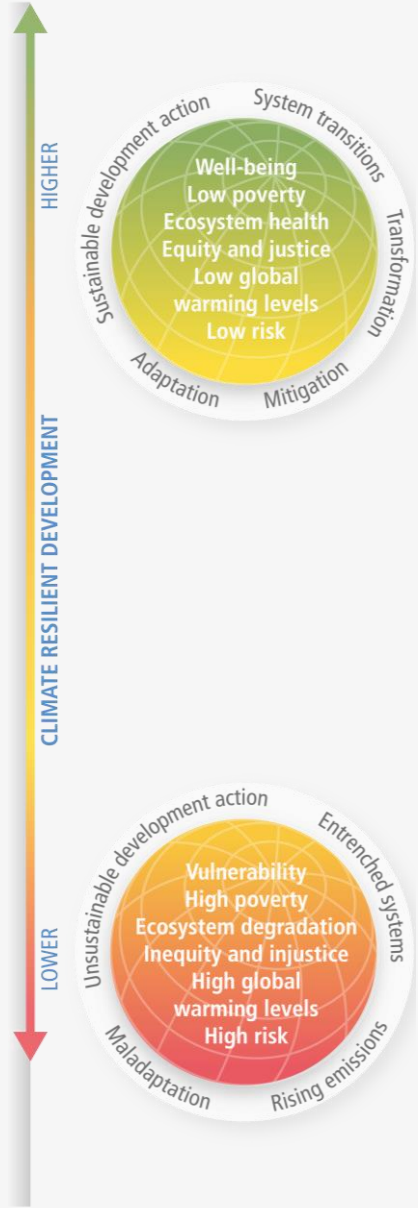


[Mika Baumeister / Unsplash; Aulia Erlangga/CIFOR CC BY-NC-ND 2.0]

Climate Resilient Development

The solutions framework:

- Requires scaled-up investment and international cooperation

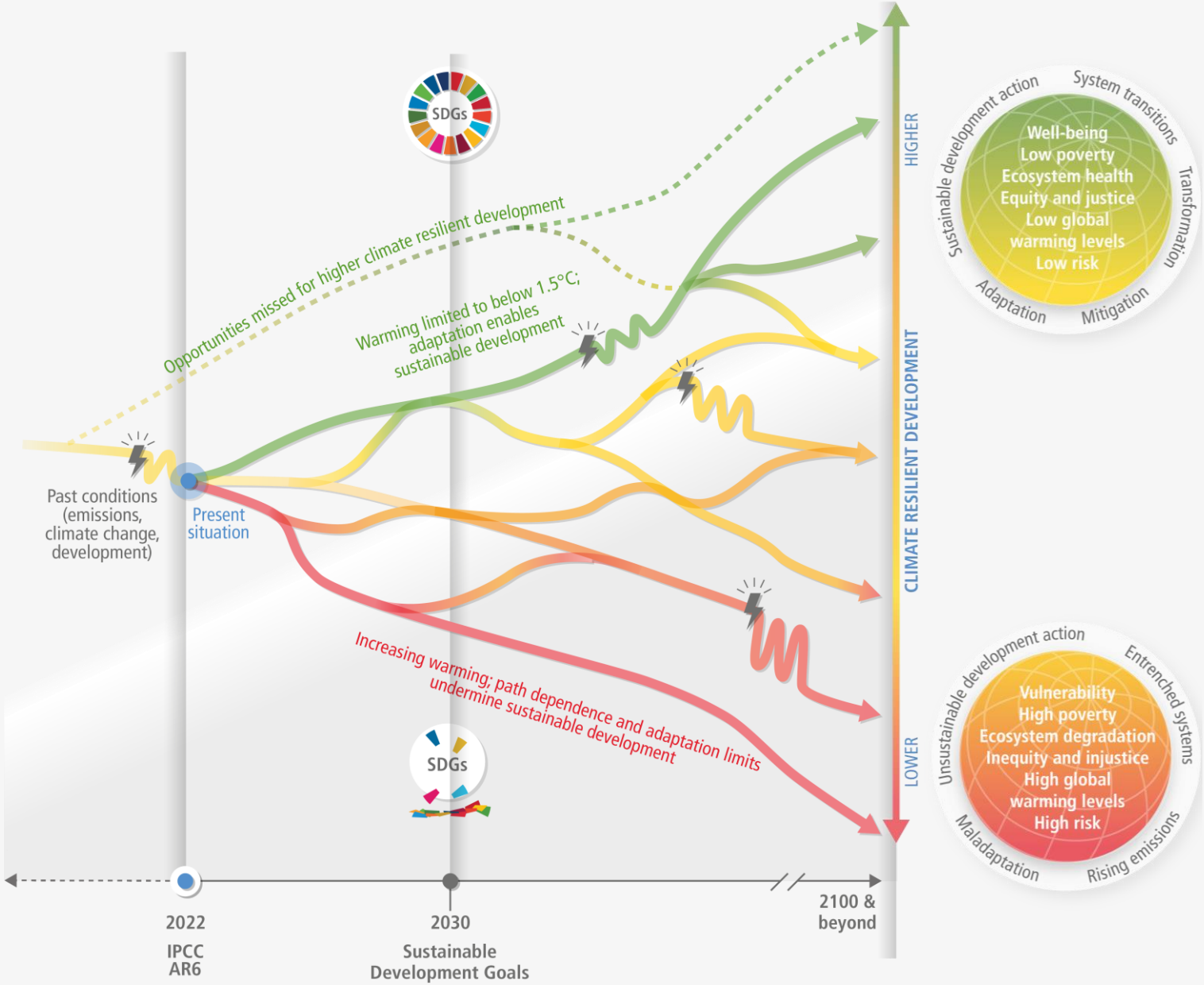


[Kumerra Gemechu/CIFOR CC BY-NC-ND 2.0, Thisisengineering Raeng / Unsplash]

Increasing urgency

Starting today, every action, every decision matters.

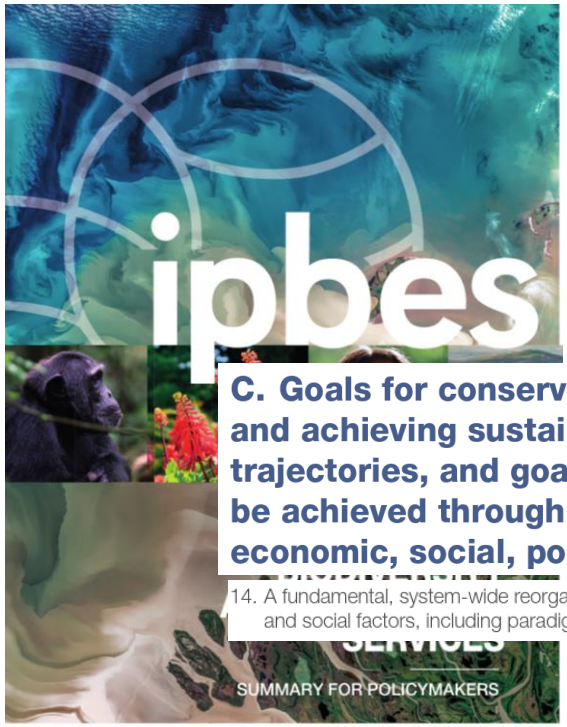
Worldwide action is more urgent than previously assessed.



4. Transformation

Transformation

2018



C. Goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, and goals for 2030 and beyond may only be achieved through transformative changes[14] across economic, social, political and technological factors.

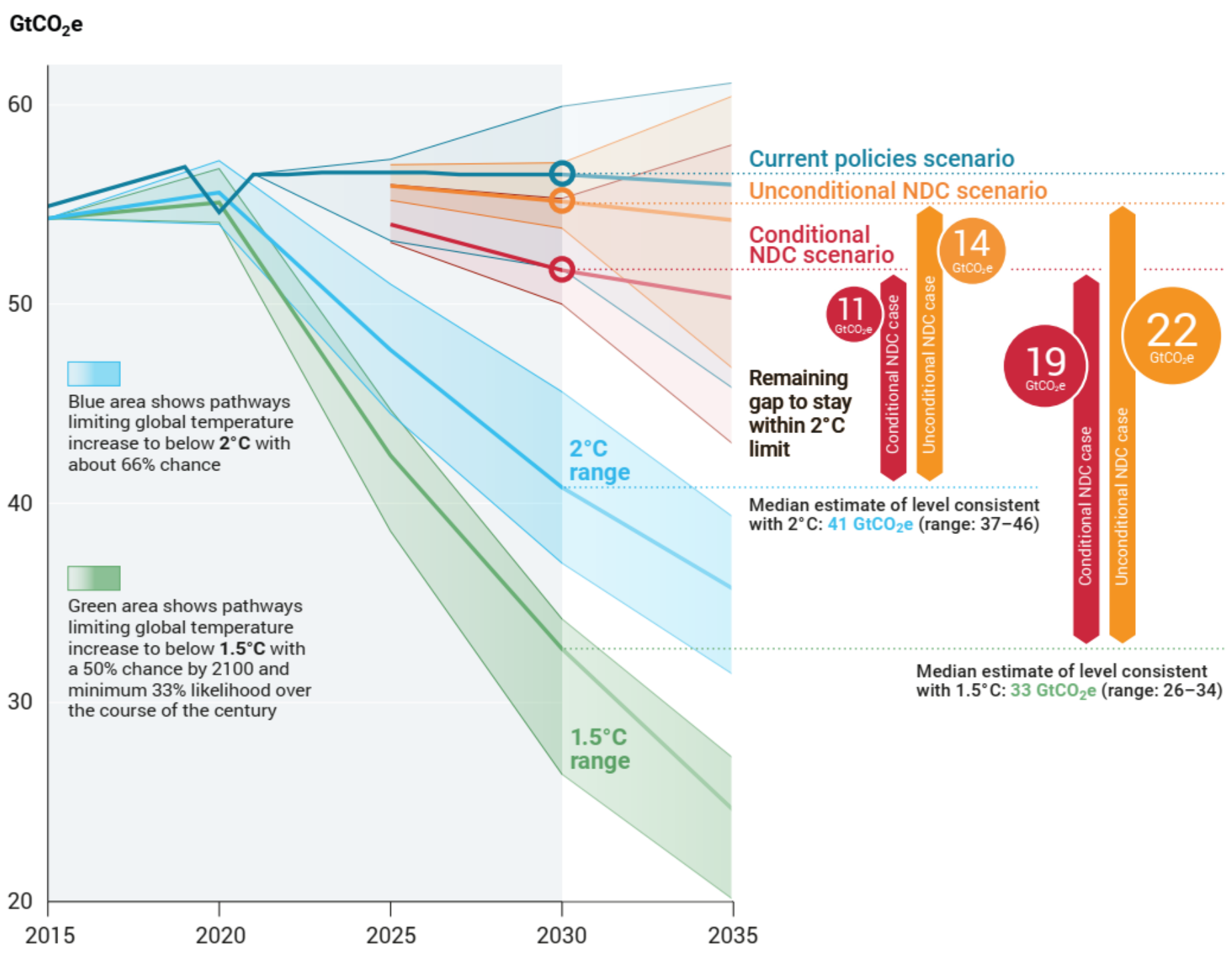
14. A fundamental, system-wide reorganization across technological, economic and social factors, including paradigms, goals and values.

2019

ipbes

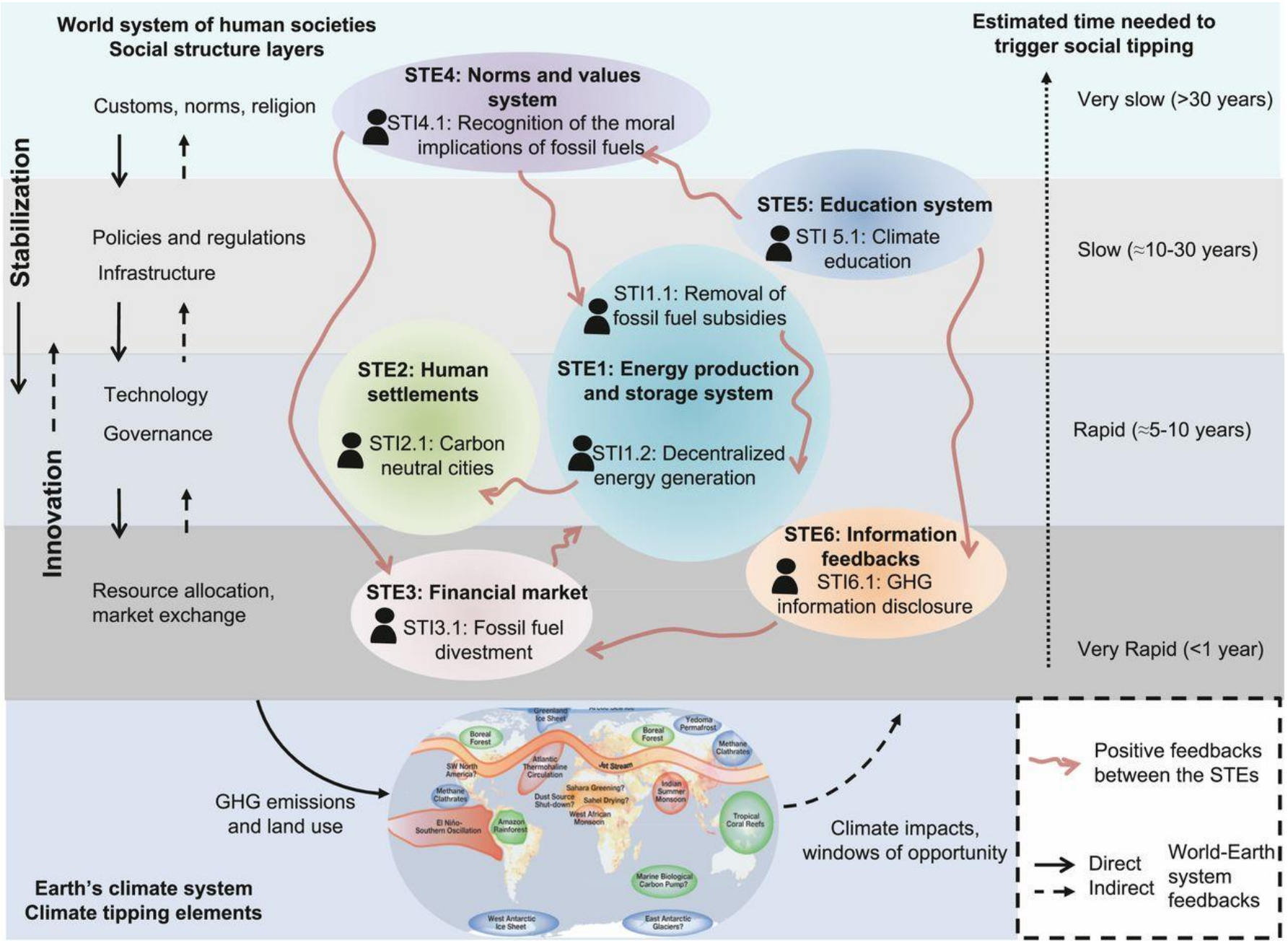
C.2 Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (*high confidence*). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (*medium confidence*). {2.3, 2.4, 2.5, 4.2, 4.3, 4.4, 4.5}


UN environment programme
Broken Record
Temperatures hit new highs, yet world fails to cut emissions (again)
Emissions Gap Report 2023

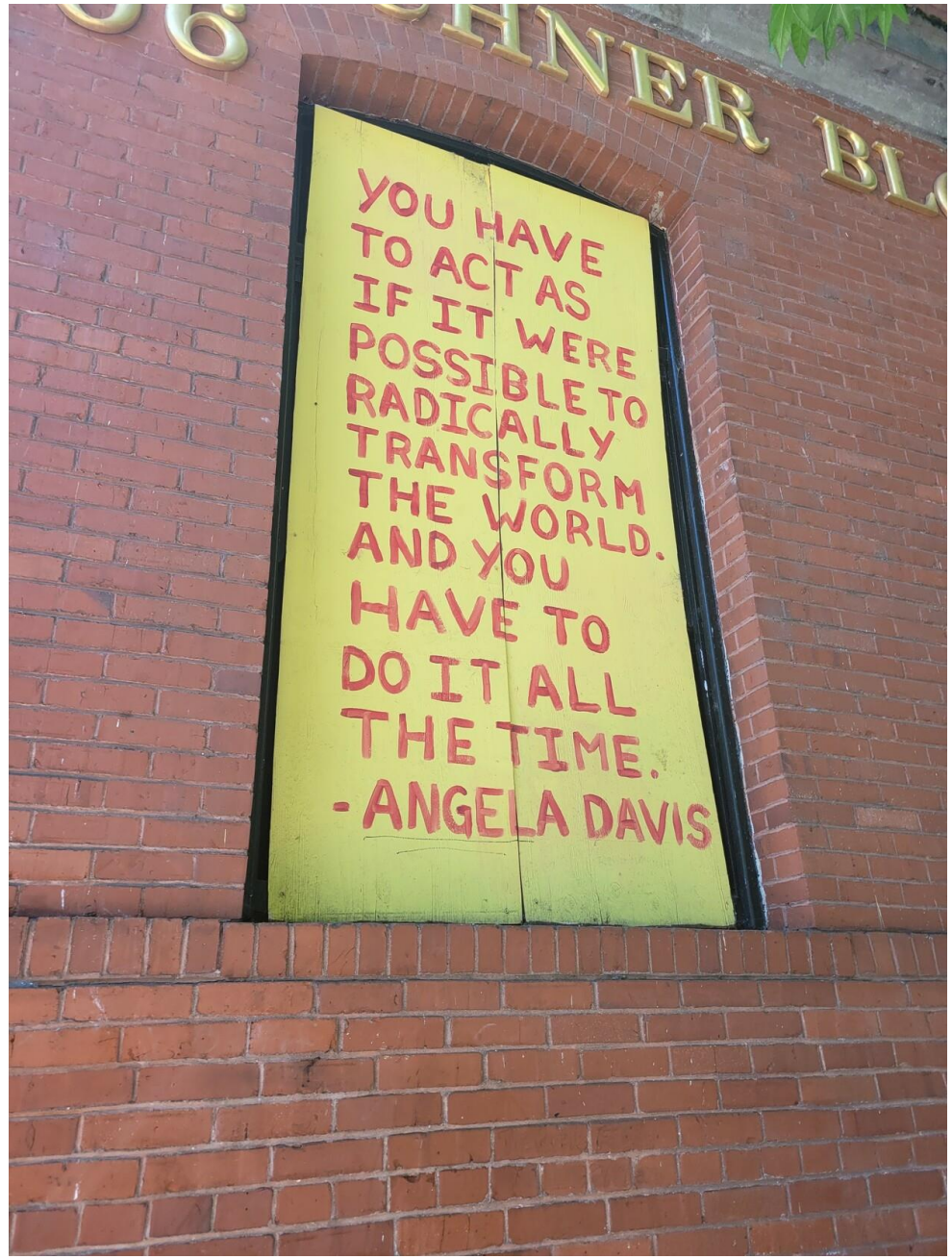

GtCO2e
60
50
40
30
20
2015
2020
2025
2030
2035
Blue area shows pathways limiting global temperature increase to below 2°C with about 66% chance
Green area shows pathways limiting global temperature increase to below 1.5°C with a 50% chance by 2100 and minimum 33% likelihood over the course of the century
2°C range
1.5°C range
Current policies scenario
Unconditional NDC scenario
Conditional NDC scenario
Remaining gap to stay within 2°C limit
11 GtCO2e
Conditional NDC case
Unconditional NDC case
14 GtCO2e
Median estimate of level consistent with 2°C: 41 GtCO2e (range: 37–46)
19 GtCO2e
Conditional NDC case
Unconditional NDC case
22 GtCO2e
Median estimate of level consistent with 1.5°C: 33 GtCO2e (range: 26–34)


AIRFRANCE
SKYTEAM
AIRFRANCE KLM
PB

Sainte-Soline, France, March 2023



Otto et al 2020


YOU HAVE
TO ACT AS
IF IT WERE
POSSIBLE TO
RADICALLY
TRANSFORM
THE WORLD.
AND YOU
HAVE TO
DO IT ALL
THE TIME.
- ANGELA DAVIS